Correspondence

Journal of Hypertension 2007, **25**:1974–1977

Tai chi for cardiovascular disease and its risk factors: a systematic review

Myeong Soo Lee[a], Max H. Pittler[a], Ruth E. Taylor-Piliae[b] and Edzard Ernst[a]

[a]Complementary Medicine, Peninsula Medical School, Universities of Exeter and Plymouth, Exeter, UK and [b]Stanford Prevention Research Center, Stanford University School of Medicine, Stanford, California, USA

Correspondence to Myeong Soo Lee, PhD, Complementary Medicine, Peninsula Medical School, Universities of Exeter and Plymouth, Exeter EX2 4NT, UK
Tel: +44 01392 439035; fax: +44 01392 427562;
e-mail: myeong.lee@pms.ac.uk or drmslee@gmail.com

Cardiovascular disease (CVD) is a leading cause of morbidity and mortality and is responsible for one in three deaths [1]. Mind–body interventions such as tai chi are complementary therapies that are frequently used [2]. Tai chi may have some benefit in preventing or treating CVD. The objective of this systematic review and meta-analysis was to assess the evidence of tai chi for CVD and its risk factors.

Databases searched from their respective inceptions through to March 2007 were: MEDLINE, AMED, British Nursing Index, CINAHL, EMBASE, PsycInfo, the Clinical Trials.gov of the National Institute of Health and National Research Register, Korean Medical Databases, Chinese Academic Journals Databases (CNKI), and the Cochrane Library 2007, issue 1. There were no language restrictions. The search terms used were: 'taichi', 'tai adj chi' or 'tai chi chun' and 'cardiovascular', 'heart', 'stroke', 'myocardial infarction', 'peripheral arterial occlusive disease', 'hypertension', 'diabetes', 'obesity', 'physical inactivity', 'stress', 'cholesterol' or 'smoking'. In addition, the references of all located articles and the proceedings of the 1st International Conference of Tai Chi for Health (December 2006, Seoul, South Korea) were hand-searched for further relevant articles.

Prospective, randomized, controlled clinical trials of tai chi for CVD or any of its risk factors were included. Trials comparing tai chi with any type of control group were included. A modified Jadad score was used [3] whereby a point was given for blinding if the outcome assessor was blinded. The mean change in blood pressure compared with baseline was defined as the primary endpoint, and was used to assess the difference between the intervention groups and control groups.

The literature searches identified 164 potentially relevant studies of which nine randomized, controlled trials (RCTs) were included (Table 1). One ongoing RCT, which is funded by the National Center for Complementary and Alternative Medicine, tests tai chi for chronic heart failure compared with an education programme.

Table 1 Key data of randomized clinical trials of tai chi for cardiovascular diseases and its risk factors with parallel group design

First author	Conditions sample size (randomized/analysed)	Jadad score, allocation concealment	Control intervention	Main outcome measure	Intergroup differences
Channer [11]	Acute myocardial infarction 126/65	2, n.r.	(A) Aerobic exercise (B) Non-exercise support	(1) SBP and DBP (2) HR	Tai chi vs (A) (1) NS (2) $P<0.001$
Young [6]	Hypertension 62/60	4, n.r., AB	Aerobic exercise	(1) SBP and DBP (2) Maximal aerobic capacity	(1), (2) NS
Tsai [4]	Hypertension 88/76	4, n.r., AB	No treatment	(1) SBP and DBP (2) Lipid profile	n.r.
Hart [7]	Stroke 18/n.r.	2, n.r., AB	Group balancing exercises	(1) Balance test (2) Speed of walking	n.r.
Lee [8]	Hypertension 50/28	2, n.r.	No treatment	(1) SBP and DBP (2) Total cholesterol	(1) SBP, $P<0.004$; DBP, $P<0.001$ (2) NS
Yeh [5]	Chronic heart failure 30/30	3, adequate	Usual care	(1) Quality of life (2) 6-Min walking distance (3) Incidence of arrythmia	(1) $P<0.001$ (2) $P<0.001$ (3) NS
Wen [10]	Hypertension 36/n.r.	1, n.r.	No treatment	(1) SBP and DBP (2) HR	(1) SBP, $P<0.05$; DBP, $P<0.05$ (2) NS
Orr [12]	Type 2 diabetes 38/35	1, n.r.	Sham exercise	(1) Mobility (2) Gait speed	(1), (2) NS
Mao [9]	Hypertension 62/62	2, n.r.	No treatment	(1) SBP and DBP (2) Nitric oxide	(1) SBP, $P<0.01$; DBP, $P<0.01$ (2) $P<0.01$

AB, assessor blind; DBP, Diastolic blood pressure; HR, heart rate; n.r., not reported; NS, no significant difference; SBP, systolic blood pressure.

0263-6352 © 2007 Lippincott Williams & Wilkins

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

Of the nine included RCTs, three described the methods of randomization [4–6] and three described assessor blinding [4,6,7]. Only one trial reported details on allocation concealment [5]. Four studies [4,8–10] suggested significant blood pressure reduction in hypertensive patients compared with no treatment [$n = 166$, weighted mean difference (mmHg), systolic blood pressure (SBP) −21.48, 95% confidence interval (CI) −25.83 to −17.13, $P < 0.001$, heterogeneity $\chi^2 = 0.43$, $P = 0.81$, $I^2 = 0\%$; and diastolic blood pressure (DBP) −12.05, 95% CI −15.31 to −8.78, $P < 0.001$, heterogeneity $\chi^2 = 0.02$, $P = 0.99$, $I^2 = 0\%$]. Two RCTs compared tai chi with aerobic exercise in patients with hypertension [6] or acute myocardial infarction [11].

There is some evidence from RCTs suggesting blood pressure reduction in patients with hypertension. The effects observed, compared with no treatment, may suggest effectiveness against the natural course of disease, but provides little information about any specific effects [4,8–10]. Whether the findings of no difference compared with aerobic exercise reflects equivalence of effects is as yet unclear. For other CVD such as stroke and chronic heart failure there is also some indication that tai chi may be helpful. None of the reviewed trials reported any adverse events.

The limitations of our systematic review, and indeed systematic review in general, pertain to the potential incompleteness of the evidence reviewed [13,14]. We are confident, however, that our search strategy has located all relevant data on the subject. In this systematic review there were no restrictions in terms of publication language and a large number of different databases were searched.

In conclusion, the evidence on tai chi for CVD and its risk factors is scarce. For hypertension the evidence is encouraging, suggesting potential effectiveness. The number of trials and the total sample sizes are, however, too small to draw any firm conclusions.

Acknowledgements

M.S.L. was supported by the Korean Research Foundation Grant (M01-2005-214-10334-0).

References

1 World Health Organization. WHO CVD-risk management package for low- and medium-resource settings. Geneva: WHO; 2002.
2 Yeh GY, Davis RB, Phillips RS. Use of complementary therapies in patients with cardiovascular disease. *Am J Cardiol* 2006; **98**:673–680.
3 Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996; **17**:1–12.
4 Tsai JC, Wang WH, Chan P, Lin LJ, Wang CH, Tomlinson B, *et al.* The beneficial effects of Tai Chi Chuan on blood pressure and lipid profile and anxiety status in a randomized controlled trial. *J Altern Complement Med* 2003; **9**:747–754.
5 Yeh GY, Wood MJ, Lorell BH, Stevenson LW, Eisenberg DM, Wayne PM, *et al.* Effects of tai chi mind–body movement therapy on functional status and exercise capacity in patients with chronic heart failure: a randomized controlled trial. *Am J Med* 2004; **117**:541–548.
6 Young DR, Appel LJ, Jee S, Miller ER III. The effects of aerobic exercise and T'ai Chi on blood pressure in older people: results of a randomized trial. *J Am Geriatr Soc* 1999; **47**:277–284.
7 Hart J, Kanner H, Gilboa-Mayo R, Haroeh-Peer O, Rozenthul-Sorokin N, Eldar R. Tai Chi Chuan practice in community-dwelling persons after stroke. *Int J Rehabil Res* 2004; **27**:303–304.
8 Lee EN. The effects of tai chi exercise program on blood pressure, total cholesterol and cortisol level in patients with essential hypertension. *Taehan Kanho Hakhoe Chi* 2004; **34**:829–837; [in Korean].
9 Mao HN, Sha P. Effect of tai chi exercise on blood pressure, plasma nitrogen monoxidium and endothelin in hypertension patients. *Chin J Clin Rehabil* 2006; **10**:66–67; [in Chinese].
10 Wen J, Kang YS. Tai chi breathing training on BP, HR, EEG and mood in seniors with essential hypertension. *Med Sci Sports Exerc* 2005; **37**:S255; [Abstract].
11 Channer KS, Barrow D, Barrow R, Osborne M, Ives G. Changes in haemodynamic parameters following Tai Chi Chuan and aerobic exercise in patients recovering from acute myocardial infarction. *Postgrad Med J* 1996; **72**:349–351.
12 Orr R, Tsang T, Lam P, Comino E, Singh MF. Mobility impairment in type 2 diabetes: association with muscle power and effect of Tai Chi intervention. *Diabetes Care* 2006; **29**:2120–2122.
13 Ernst E, Pittler MH. Alternative therapy bias. *Nature* 1997; **385**:480.
14 Pittler MH, Abbot NC, Harkness EF, Ernst E. Location bias in controlled clinical trials of complementary/alternative therapies. *J Clin Epidemiol* 2000; **53**:485–489.

Evolution of blood pressure control in Spain

Vivencio Barrios[a], José R. Banegas[b], Luis M. Ruilope[c] and José L. Rodicio[d]

[a]Department of Cardiology, Hospital Ramón y Cajal, Madrid, [b]Department of Preventive Medicine and Public Health, Autonomous University, Madrid, [c]Hypertension Unit, Doce de Octubre Hospital, Madrid and [d]Faculty of Medicine, Complutense University, Madrid, Spain

Correspondence to Vivencio Barrios, Department of Cardiology, Hospital Ramón y Cajal, Ctra. De Colmenar km 9, 100. 28034 Madrid, Spain
Tel: +34 913369259; fax: +34 913368665;
e-mail: vbarriosa@meditex.es/vbarrios.hrc@salud.madrid.org

Hypertension is very prevalent in industrialized countries. In the United States it is estimated that more than a quarter of the population has hypertension [1]. In Spain, it is responsible for approximately one out of four total deaths and one out of 2.5 cardiovascular deaths [2]. Blood pressure control is crucial in the prevention of cardiovascular disease, and blood pressure lowering appears critical in reducing the risk of cardiovascular outcomes and preventing major coronary events [3,4]. Even small blood pressure decreases imply a significant reduction in adverse outcomes [5]. The better blood pressure control attained in Spain in the past decade has thus reduced the incidence of stroke [6]. Studies suggest that although hypertension is underdiagnosed and undertreated, there has been an improvement in blood pressure control rates in Europe and the United States [1,7].

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

Studies carried out in the early 1990s in Spain on blood pressure control showed a very low proportion of patients achieving blood pressure goals. This may have very important implications, taking into account that at present the majority of patients with hypertension seen daily in outpatient clinics, not only in specialist settings but also in primary care, belong to the medium or high coronary risk groups [8]. As a result, some strategies have been developed to raise physician and patient awareness about the importance of blood pressure control, mainly through continuous medical education. In the past 15 years, several population-based studies and clinical practice surveys have focused on blood pressure control in the Spanish population, and have recently shown a progressive improvement, from only approximately 15% of blood pressure control among treated hypertensive patients in the early 1990s to 30–40% now [9–16]. This improvement is even more relevant, taking into account that in the past few years the thresholds for blood pressure control have lowered [17].

More specifically, blood pressure control among treated hypertensive patients in the Spanish primary care setting was 13% in 1995, 36.1% in 2001, and 38.8% in 2003 [15], and in the specialized setting (hospital-based hypertension units) it was 42% in 2001 and 47% in 2004 [16]. Finally, in samples representative of the adult non-institutionalized general population, blood pressure control among treated hypertensive patients increased from 16% in 1990 to 29% in 2001 [8,14]. A recent study has also shown that blood pressure control in adult treated hypertensive patients based on ambulatory blood pressure monitoring (50%) is much better than blood pressure control as measured in the office [18]. Therefore, blood pressure control in Spain, probably as in other developed countries, is better than previously believed.

An improvement in blood pressure control has been shown in most western European countries and in the United States, but also in Spain [1,7]. Although the prevalence of hypertension has not changed in the United States during the past 5 years, blood pressure control rates have increased from 29.2% in 1999–2000 to 36.8% in 2003–2004 [1]. Some potential explanations for the improvement in blood pressure control in Spain may be related to better knowledge and adherence to hypertension guidelines and the major concern about this important public health problem [19,20].

Although these data are hopeful, however, it must not be forgotten that at best more than 50% of patients with hypertension are undercontrolled in Spain. Therapeutic inertia, an underestimation of cardiovascular risk in the hypertensive population, the great misperception that physicians and patients have about patient blood pressure control rates, the difficulty in achieving blood pressure objectives, the underrating of systolic blood pressure, and the low use of combined therapy and therapeutic compliance are some of the deficiencies that may be improved in the next few years [19–21].

References

1 Ong KL, Cheung BM, Man YB, Lau CP, Lam KS. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999–2004. *Hypertension* 2007; **49**:69–75.

2 Banegas JR, Rodriguez-Artalejo F, Graciani A, Villar F, Herruzo R. Mortality attributable to cardiovascular risk factors in Spain. *Eur J Clin Nutr* 2003; **57 (Suppl 1)**:S18–S21.

3 McMahon S, Peto R, Cutler J, Collins R, Sorlie P, Neaton J, *et al.* Blood pressure, stroke, and coronary heart disease. Part 1, Prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *Lancet* 1990; **335**:765–774.

4 Zanchetti A, Julius S, Kjeldsen S, McInnes GT, Hua T, Weber M, *et al.* Outcomes in subgroups of hypertensive patients treated with regimens based on valsartan and amlodipine: an analysis of findings from the VALUE trial. *J Hypertens* 2006; **24**:2163–2168.

5 Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet* 2002; **360**:1903–1913.

6 Banegas JR, Rodriguez F. Cardiovascular risk in the Spanish population. Geographical heterogeneity? *Rev Clin Esp* 2004; **204**:611–613.

7 Wang YR, Alexander GC, Stafford RS. Outpatient hypertension treatment, treatment intensification, and control in Western Europe and the United States. *Arch Intern Med* 2007; **167**:141–147.

8 Barrios V, Escobar C, Calderon A, Echarri R, Gonzalez-Pededl V, Ruilope LM. Cardiovascular risk profile and risk stratification of the hypertensive population attended by general practitioners and specialists in Spain. The CONTROLRISK study. *J Hum Hypertens* 2007; **21**:479–485.

9 Banegas JR, Rodriguez-Artalejo F, de la Cruz Troca JJ, Guallar-Castillon P, del Rey Calero J. Blood pressure in Spain: distribution, awareness, control, and benefits of a reduction in average pressure. *Hypertension* 1998; **32**:998–1002.

10 Coca A. Actual blood pressure control: are we doing things right? *J Hypertens Suppl* 1998; **16**:S45–S51.

11 Alvarez-Sala LA, Suarez C, Mantilla T, Franch J, Ruilope LM, Banegas JR, Barrios V. PREVENCAT study: control of cardiovascular risk in primary care. *Med Clin (Barc)* 2005; **124**:406–410.

12 Llisterri JL, Rodriguez GC, Alonso FJ, Lou S, Divison JA, Santos JA, *et al.* Blood pressure control in Spanish hypertensive patients in primary healthcare centres. PRESCAP 2002 Study. *Med Clin (Barc)* 2004; **122**:165–171.

13 Barrios V, Escobar C, Calderon A, Llisterri JL, Echarri R, Alegria E, *et al.* Blood pressure and lipid goal attainment in the hypertensive population assisted in the primary care setting in Spain. *J Clin Hypertens* 2007; **9**:324–329.

14 Banegas JR, Rodríguez-Artalejo F, Ruilope LM, Graciani A, Luque M, de la Cruz-Troca JJ, *et al.* Hypertension magnitude and management in the elderly population of Spain. *J Hypertens* 2002; **20**:2157–2164.

15 Coca A. Evolution of arterial hypertension control in primary care setting in Spain. Results from the Controlpres 2003 study [in Spanish]. *Hipertensión* 2005; **22**:5–14.

16 Banegas JR, Segura J, Ruilope LM, Luque M, García-Robles R, Campo C, *et al.* Blood pressure control and physician management of hypertension in hospital hypertension units in Spain. *Hypertension* 2004; **43**:1338–1344.

17 Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, *et al.* Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003; **42**:1206–1252.

18 Banegas JR, Segura J, Sobrino J, Rodríguez-Artalejo F, Sierra A, Cruz JJ, *et al.* Effectiveness of blood pressure control outside the medical setting. *Hypertension* 2007; **49**:62–68.

19 Gonzalez JR, Alegria E, Aznar J, Bertomeu V, Franch J, Palma JL. Knowledge and implementation of cardiovascular risk clinical practice guidelines by general practitioners and specialists. *Rev Esp Cardiol* 2006; **59**:801–806.

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

20 Garcia-Pavia P, Gonzalez J, Pastorin R, Bruna M, Raez J, Tabuenca Al, *et al.* Epidemiological analysis of the improving areas for blood pressure control at primary care practice. *Rev Clin Esp* 2006; **206**:220–224.
21 Coca A, Aranda P, Bertomeu V, Bonet A, Esmatjes E, Guillen F, *et al.* Strategies for effective control of arterial hypertension in Spain. Consensus document. *Rev Clin Esp* 2006; **206**:510–514.

A case of pheochromocytoma symptomatic after delivery

Klaus Kisters[a,b], Peter Franitza[a] and Martin Hausberg[b]

[a]Department of Internal Medicine 1, St Anna Hospital, 44649 Herne and [b]Department of Internal Medicine D, University of Muenster Hospitals and Clinics, 48129 Muenster, Germany

Correspondence to Martin Hausberg, MD, Department of Internal Medicine D, University of Muenster Hospitals and Clinics, 48149 Münster, Germany
Tel: +49 251 8347539; fax: +49 251 8346979;
e-mail: hausber@uni-muenster.de

A hormone-secreting adrenal mass as a cause of secondary hypertension is a rather rare condition [1,2]. The correct diagnosis of endocrine hypertension remains a difficult task. As outlined by Manger [3], a large proportion of pheochromocytomas are only discovered at autopsy, because this tumour is often not suspected. In this context, we report the case of a 34-year-old woman who delivered her first child after an uneventful term pregnancy. Blood pressure during pregnancy never exceeded 135/85 mmHg. The patient never suffered from sweating, headache or palpitations during her pregnancy. She had no history of medical disease, and also there was no family history of hypertension or endocrine disease. Before her pregnancy, however, she occasionally complained of dizziness and headaches, but never sought medical advice for this. Three day after the uncomplicated delivery of a healthy newborn the patient suddenly developed severe hypertension, with blood pressure levels up to 290/140 mmHg, accompanied by headache and nausea. Abdominal ultrasound revealed a left adrenal mass. Urinary norepinephrine excretion was 479 μg/24 h, urinary epinephrine excretion was 271 μg/24 h, thus more than fivefold, respectively 10-fold elevated. I-123 MIBG scintigraphy revealed intense tracer accumulation in the left adrenal region, consistent with a pheochromocytoma. There were no further lesions. Genetic analysis did not reveal any mutations of the VHL, SDHB, SDHD or RET genes nor deletions of the VHL gene. Furthermore, thryroid ultrasound and analysis of serum calcitonin and parathyroid hormone did not reveal any abnormalities. The patient's blood pressure was controlled by phenoxybenzamine, later on in combination with metoprolol. Three weeks later the left adrenal gland with a pheochromocytoma of 5 cm in size was surgically removed. After surgery, the patient was normotensive and did not require any antihypertensive medication.

A pheochromocytoma diagnosed in pregnancy is a rare condition [4]. Published case reports describe pheochromocytomas mimicking severe pre-eclampsia or causing hypertensive emergencies during delivery [4]. The patient reported here, however, developed symptoms only 3 days after delivery despite a large pheochromocytoma. The initial likelihood of pheochromocytoma in this case of postpartum hypertension was low. The rapid and consequent diagnostic evaluation of an adrenal mass during pregnancy or postpartum is mandatory because pheochromocytoma-related hypertensive emergencies during pregnancy and delivery have a grim prognosis, as shown by the published case of a woman diagnosed on autopsy [5].

References

1 Reisch N, Peczkowska M, Januszewicz A, Neumann HP. Pheochromocytoma – presentation, diagnosis and treatment. *J Hypertens* 2006; **24**:2331–2339.
2 Eisenhofer G. Pheochromocytoma: recent advances and speed bumps in the road to further progress. *J Hypertens* 2006; **24**:2341–2343.
3 Manger WM. Diagnosis and management of pheochromocytoma – recent advances and current concepts. *Kidney Int Suppl* 2006; **104**:S30–S35.
4 Grodski S, Jung C, Kertes P, Davies M, Banting S. Phaeochchromocytoma in pregnancy. *Intern Med J* 2006; **36**:604–606.
5 Cermakova A, Knibb AA, Hoskins C, Menon G. Postpartum phaeochromocytoma. *Int J Obstet Anesth* 2003; **12**:300–304.

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.